Making cities wiser - Crowdsourcing for better decisions

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SUMMARY

The need in urban planning to make knowledge-driven decisions has spurred the creation of new solutions to gather and utilize insight from residents. Participatory planning has often been realized through workshops and during face-to-face encounters, but little of the knowledge gathered in these situations is of use in further urban planning and city development. New technological innovations, such as map-based public participation tools, support gathering information that matters and makes cities wiser. Interaction with citizens not only creates information, but supports also learning and innovation building, and creates trusts.

Technological innovations like Maptionnaire help gather information that makes cities wiser. Maptionnaire is a leading solution for collecting, analyzing and discussing resident insight on a map. With the help of Maptionnaire, various cities have been able to change their modus operandi. Through these learning processes actors from different sectors of the city are brought together to create joint understanding of the possibilities of public participation. Cities have started to value and use resident input as an equally important part of its knowledge base for planning. There is a great potential for more efficient use of participatory tools to make processes smoother and to save money. Future development work is needed to further facilitate knowledge transfer from residents to the use of planners and other city officials.

In our presentation we will present different innovative case studies from Finland and abroad where Maptionnaire has been used to support two-way communication in different phases of planning processes. Based on our findings we will draft a new public participation model that assist the effective gathering of experiential knowledge from inhabitants, provide high quality place-based data for various analysis and informs participants about the stage and goals of the planning process more innovatively.

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1. INTRODUCTION

Urban planning is constantly seeking a balance between how to develop and change existing living environments while maintaining their valuable, existing character. This challenge has become acute in many growing cities around the world, that share the same concern, how to shape the existing city structure without reducing the very qualities of the living environment people value most.

Cities are simultaneously becoming smarter in the ways they use various sources of digital knowledge that aim to support their growth, sustainability and usability. To plan cities wisely a broad group of actors is needed. A central task of a planner is to construct linkages between the differing actors of civic society and support them by digital tools and processes. As such, the role of the urban planner in the smart network society is turning into that of the facilitator who understands the ongoing complex development patterns. Digitalisation can enhance participation and integrate the differing voices of plural society more efficiently. Traditional face-to-face participation methods can be supplemented by tools utilizing social media and other information and communication technologies (ICT) like web-based geographic information systems (webGIS). The central question is not who organises participation but how the different participation practices – formal and informal - can be linked together and the information produced adapted to the planning process.

The more democratic and efficient participatory planning processes demand that we consider the opportunities for greater public involvement. With the existing participation methods and procedures like public hearings, workshops etc. a truly inclusive and effective public involvement cannot be attained while these methods attract merely participants that are able and used to express their opinions. Urban planning practices should be more open to dissenting opinions expressed by the general public. Though digitalization has brought many new and inspiring tools to support more extensive participation, the utilisation and usefulness of them need to be considered carefully in relation to the specific planning process at hand.

One example of the ongoing digitalisation process emerging in the participatory urban planning context is the set of webGIS tools such as public participation GIS (PPGIS) methods. This article introduces one of these tools, called Maptionnaire, that has been used in the field of urban planning and that was originally developed in Aalto University in Finland. We will introduce the tool, give examples of it's usage in various stages of the planning process and introduce a heuristic model - participatory planning support system (PPSS) that emphasises the usability and benefits of the PPGIS tools during different phases of the planning process.

1. BACKGROUND OF THE PUBLIC PARTICIPATION GIS (PPGIS)

Researchers and practitioners from different backgrounds have brought diverse vocabulary to the field of participatory GIS (e.g. Brown & Kyttä 2014). Location based data collected from informal

sources can be divided roughly into Volunteer Geographic Information (VGI) and data collected through Public Participation Geographic Information Systems (PPGIS). VGI is data that is not solicited: it is provided by volunteers spontaneously. Notable VGI projects include Wikimapia[1] and OpenStreetMap[2]. In contrast, PPGIS data is solicited from participants by a particular agency, for example during a university research project or through participation in a planning process.

Tulloch (2008) describes PPGIS as a field within geographic information science that focuses on the ways in which the public uses various forms of geospatial technologies to participate in different processes. PPGIS also enables communication to take place on maps and models in an intelligible visual form to those who have no expertise in its technical basis (Carver, Evans, Kingston, & Turton, 2001).

Both PPGIS and VGI are related terms that define a process for gathering and using non-expert spatial information (Brown & Kyttä, 2014). While PPGIS tools are often web-based, originating from the hands of researchers, VGI tools are generally developed by lay people to create, assemble, and disseminate voluntarily produced geographic data (Goodchild, 2007; Hall, Chipeniuk, Feick, Leahy, & Deparday, 2010). VGI has led to the 'crowdsourcing' of spatial information where the user-generated content is produced by a large group of people through an online community (Sui, Elwood, & Goodchild, 2012). Although joint decision making can be understood as an object of crowdsourcing, many VGI projects have nevertheless targeted rather on geographical information gathering and visualization on certain topic. In both PPGIS and VGI, the dimensions of purpose, geographic context, data quality, sampling approaches, data collection, data ownership and dominant mapping technology vary depending on the project (Brown & Kyttä, 2014). Unlike in PPGIS projects the data validation through sampling has not been in the core of VGI projects. Although both PPGIS and VGI tools can be considered as tools that can promote data collection from a broad group of people, this does not happen automatically. In many PPGIS projects the reach has been quite limited serving only a small subset of public (Schlossberg & Shuford, 2005).

[1] "Wikimapia - Let's describe the whole world!." 4 Dec. 2014 <http://wikimapia.org/>
[2] "OpenStreetMap." 4 Dec. 2014 <http://www.openstreetmap.org/>

Figure 1 Some examples of PPGIS studies and planning practice cases.

The SoftGIS methodology developed in Aalto University since 2005 is an advanced example of PPGIS, which has been used already among over 30.000 Finns as well as in Japan, Australia, New Zealand, USA, Poland, Portugal, Iran, Austria, Germany, Mexico and Brazil. SoftGIS is an Internet-based public participation GIS (PPGIS) tool that allow the locality-based study of human experiences and the transfer of this knowledge into research and urban planning processes (Kahila & Kyttä 2009). Research themes studied with this methodology include for example environmental childfriendliness, perceived urban safety and accessibility of ecosystem services (see Figure 1). SoftGIS is grounded in environmental psychology, but zooms closer into where exactly the experiences take place [Kyttä, Broberg, & Kahila 2012].

SoftGIS developed later to a commercialized Maptionnaire service that allow anyone without any coding or GIS skills to create surveys and collect and analyze data. The Maptionnaire tool will be introduced below.

2. INTRODUCING MAPTIONNAIRE – UNIQUE PPGIS TOOL FOR YOUR USE

Maptionnaire is a cloud service for creating and analysing map-based questionnaires. Registering a test account and trying out the editor tool is free of charge. Not long ago the creation and analysis of map based questionnaires required considerable technological expertise. However, with a commercial out-of-the-box cloud service Maptionnaire, anyone can do a PPGIS study using no other tool than their web browser. In addition to academic research, city planning departments, consultancies and community engagement projects have been early adopters of map based questionnaires. We believe that this is primarily because there are higher-than-average amount of people with GIS expertise in those fields. Location matters, whether you are studying suburban

youth, business travelling, real-estate management, infrastructure projects, hiking in national parks, or shopping experiences.

2.1. Available maps

Maptionnaire includes a variety of maps. What base maps to use in a questionnaire depends on the context. Often a survey needs to contain more than one map allowing the respondent to choose the map layer of choice. The map can represent

- the future, e.g. when asking opinions or ideas about alternative town plans,
- the present, e.g. when studying the behaviour of people or their mobility patterns, or
- the past, e.g. when collecting memories of elderly citizens.

Furthermore, the maps are not limited to the geography of large areas. Small scale maps of indoor spaces such as schools, malls, or airports make for interesting topics of research tool. Maptionnaire is designed to work with essentially any digital map. This includes global commercial providers like Bing, MapBox, and Google, as well as your own WMS server that allows you to incorporate to Maptionnaire your own map-files. In addition, if your map is a georeferenced image file but you have no server of your own, it can be uploaded to our servers.

2.2. Types of map questions

Map questions can be constructed differently. Basically there are two different approaches to asking questions on map:

- The respondent draws a point, line, or area on the map. After drawing, she's given a set of follow-up questions.
- The questionnaire itself includes interactive geometries on the map. After clicking a geometry the respondent is given a set of related questions.

Who is drawing on the map makes the fundamental difference: either the creator or respondent of the questionnaire. Maptionnaire supports both.

Let us take a map questionnaire focusing on the housing preferences of urban dwellers and opinions about the future development of a city as a simple running example in how to make use of map in a survey and highlight the difference between the two question types. In Figures 3 and 4 there are illustrations of both types from the respondent's point of view.

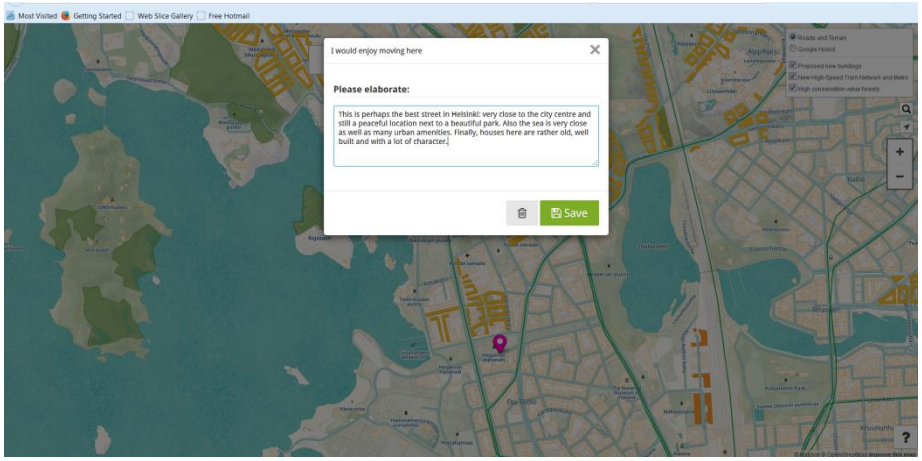

Figure 3 Placing a marker with follow-up questions, respondent's view.

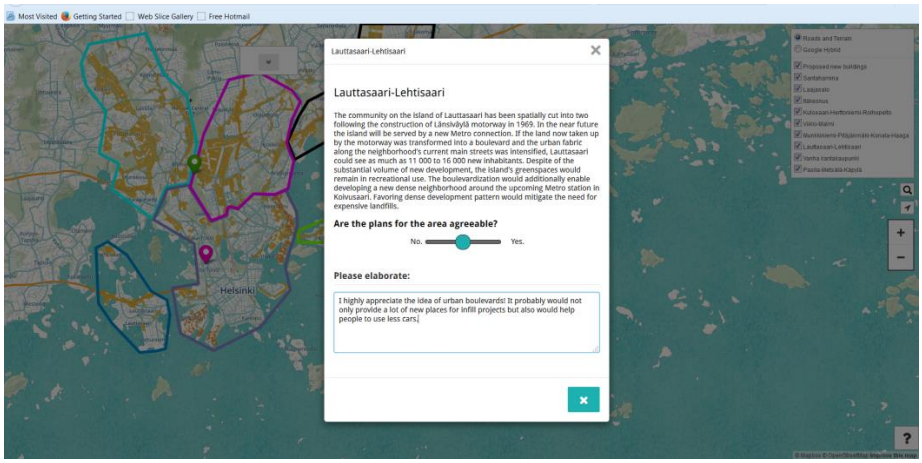

Figure 4 Choosing predefined areas with follow-up questions, respondent's view.

2.3. Output data and analysis of map data

In comparison to traditional survey data where the data comes in table format in Maptionnaire service the data includes also geocoordinates of the responses. The two main benefits of having answers with coordinates are:

- Precision and lack of ambiguity. Almost any verbal description of a location, let alone that of a route or area, is open to a lot of interpretation. In contrast, modern web maps and satellite imagery allow zooming so close that a dutiful respondent is able to pinpoint each individual tree in her neighbourhood.
- Efficiency of analysis and visualization. GIS tools let us spot patterns in large sets of location based data and infer meaningful results. In addition, it is considerably easier to communicate our findings to other people with map visualizations.

In Figure 5 there are two screen captures from the analysis tool of Maptionnaire. Above we are looking at an individual point of response data. The colors stand for different questions, e.g. "Where is the happy place, shopping place etc". Below there's a heatmap of the same points where we see the concentration of points.

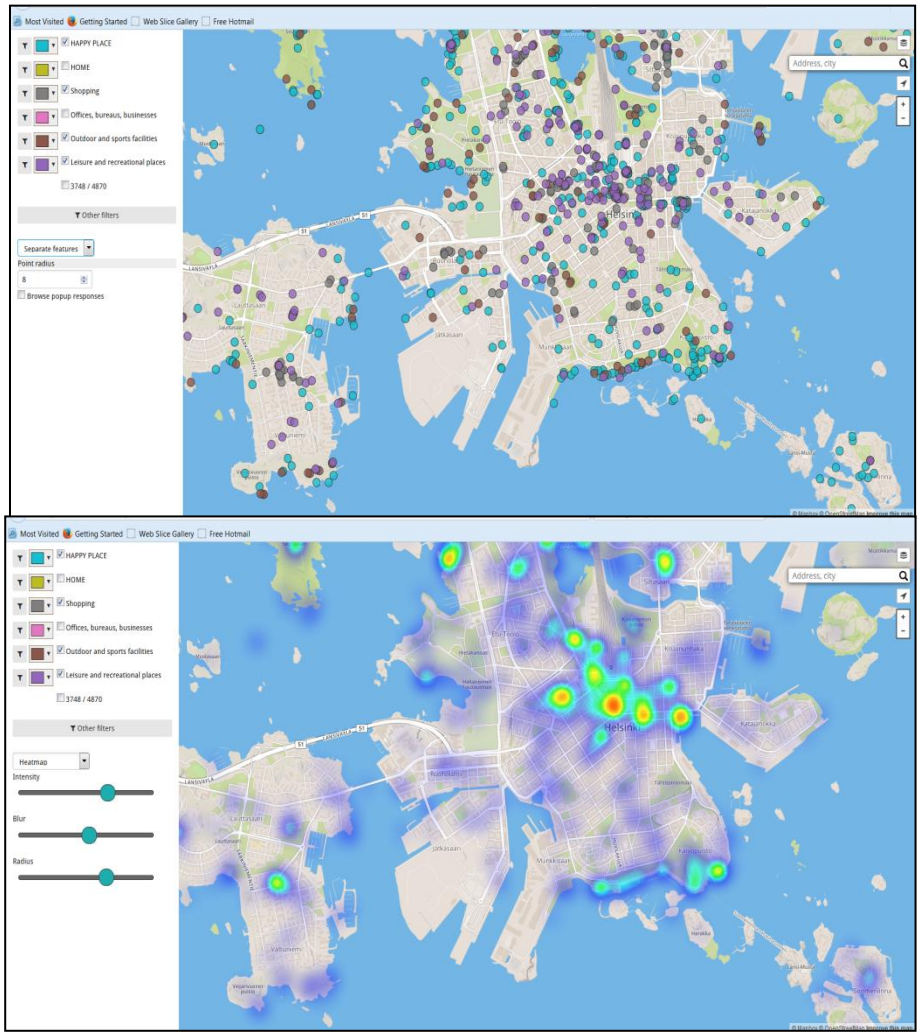

Figure 5 Maptionnaire analysis tool. Separate points (above) and heatmap (below).

Often it is convenient to share the responses with the public, such that the respondents don't feel their effort is vanishing into archives never to opened again. The map responses can be published in two ways: Directly within the questionnaire such that while answering, the respondent is able to see what others have already said. It is also possible to comment other people's answers. The analysis tool can be made public, in which case anyone can have access to the filtering, search, browsing, and visualization functions of Maptionnaire.

2.4. Integration with conventional questionnaire forms

Even though well-suited for participatory projects, Maptionnaire has its roots in scientific research. As a consequence, it comes with a full-blown questionnaire tool set. Semantic differentials, likert questions, and multiple choice questions are included and integrated with the location based data. They allow for powerful quantitative analysis and classification.

Suppose, for example, that a questionnaire

- asks the respondent's age,
- has a drawbutton "Where do you go to relax?",
- and the drawbutton has a follow-up question "What do you find there?" with options "Friends", "Time alone", "Sports", and "Art".

The analysis tool can then filter the response data according to all these variables, and for example visualize places where 50-59-year-old respondents go to do sports with friends.

Please feel free to explore the Maptionnaire editor in http://maptionnaire.com/.

3. THE USE OF PPGIS THROUGH DIFFERENT PHASES OF THE PLANNING PROCESS

The participatory planning support system (PPSS) is a conceptual approach that can be used to support planning practices with a set of participation tools and actions (Kahila-Tani 2016). It emphasizes participation as a solid and continuous part of the planning and decision making system. The focus is on different forms of knowledge, on the adaptation of new tools and on clarifying the ways in which PPGIS tools can be more profoundly embedded in the planning process. PPSS system leans on the knowledge-informed planning approach. This means (1) openness to different forms of knowledge; (2) acceptance of the conflicting perspectives of actors; (3) integration of different participatory tools and practices more profoundly into the planning process; and (4) sensitivity to local practices and context.

The following sections explore in detail the different phases of the planning process and clarify the role of participation in each phase. We will especially look at the ways how PPGIS tools can support the knowledge creation during the different phases and give examples how Maptionnaire has been used. As identified earlier, the challenge is to embed the concepts, ideas and tools in everyday practices. As such, the aim is to narrow this gap by indicating the locus of webGIS innovations throughout the planning process.

3.1. Early initiation

In the early initiation phase of a planning process, the selection of current problems and issues should be better supported by the participation process. Currently this seldom happens in urban planning. The initiation phase should acknowledge the role of informal knowledge creation through public discussions supported by digital tools but also the role of the more formal knowledge that different studies can evoke. As such, this phase can often blur into the evaluation phase (see below). Currently, the role of participants is often minimal in the early initiation phase. Both decision makers, planning authorities and interest groups such as resident unions and even individual residents could have a say and eventually affect the process of problem recognition leading to the initiation of a new planning process. Unfortunately, this kind of more extensive form of participation highlighting the plural nature of values held across society, rarely occurs.

Our observations have revealed that PPGIS tools can prove useful during this phase. They can be used for systematic and broad data collection that provide a basis for identifying problems that could be addressed in a planning project or positive qualities that should be protected. So far, there is limited evidence to show that the collected data would have significantly impacted the agenda setting phase or led to the initiation of other projects. Various VGI tools that aim to crowdsource knowledge voluntarily or argumentation maps that support capacity building and trust suit also to the initiation phase. Here, the target is rather to collect ideas and initiatives than high quality evidence. Again, it is easier to collect ideas than to find new ways to link these individual or collective ideas into a more formal process that could, eventually, lead to initiation. This demands more transparency and intense communication between planners, decision makers and residents.

Case example - Designing a campus for cycling and walking
The real estate company Aalto University Properties wanted to know how people move around the Otaniemi campus — and where transit could be improved. The aim is to create a user-friendly campus, where cycling and walking would be as smooth as possible. With a map questionnaire respondents marked their daily routes and most important places of students and employees of the campus. Additional pop up questions were asked about how these places are reached, and where new amenities are needed. The respondents gave numerous suggestions. The comprehensive survey data will be used in the long term development of the campus area and its services.

3.2. Initiation

In initiation phase the project has been formalized. The empirical findings from our studies support the involvement of the participants during the initiation phase. Residents can act as information producers as well as react to suggestions from other respondents. This way the versatile experiential landscape can be laid out that emphasises even the controversial views. The data gathering and analysis via PPGIS and VGA can be supported with face-to-face collaboration and communication to validate and supplement the data gathering. This multi-stream model of different methods confirms the initiation and demands a more thorough participatory approach.

Though our cases prove that PPGIS tools are capable of supporting the early stages of the planning process well there is also evidence to suggest that even though planners value data collection the actual use of the data after this phase has not been as effective as it could be. A number of reasons for this have been identified: (1) planners still lack the necessary skills to analyse the data, (2) planners are more interested in legitimating the participatory process by arranging possibilities for participation than in ensuring that the actual data collected is used effectively and (3) those charged with the data gathering task are usually not responsible for the actual plan making and thus are not that interested in precisely how the data is utilised.

Case Example – Thousands envisioned the Helsinki of the future
The city of Helsinki is drawing a new City plan, which will guide the development of Finland's capital until 2050. During the early phases of the process city of Helsinki wanted to hear residents' views with a map-based questionnaire (Figure 6). Survey attracted almost 4000 respondents who made over 33 000 entries in the interactive city map. The residents gave many suggestions for new building areas. They also located urban nature spots they considered unique and worth protection.

"We got an excellent number of respondents and entries. The survey was a success. Also, it was important for us to receive the analysis report directly after the end of the survey, and the analysis tool for our staff. I believe that the survey's results will be used as a background material for a wide range of future projects." — Heikki Mäntymäki, Communications Manager, City Planning Department

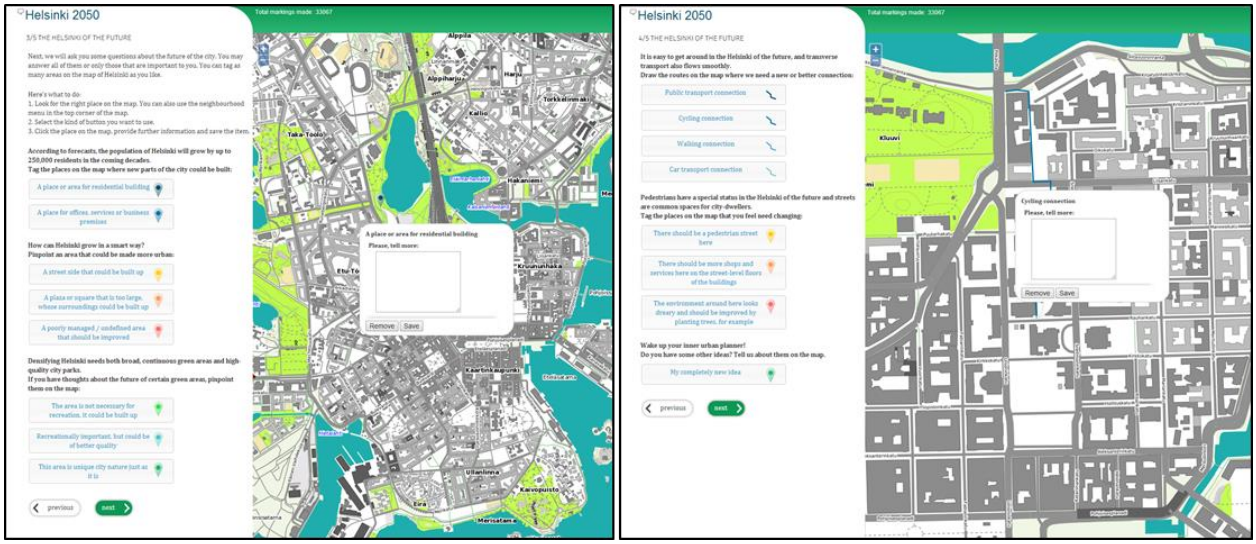

Figure 6 The Maptionnaire survey used in the participatory process of Helsinki city plan 2050.

3.3. Formulation of alternatives

During the formulation of alternatives interaction between the administrative level and the wider society often exists. Still, this interaction is often organised through stable channels such as policy networks. The formulation of the first drafts of the plan proposals is normally, at least in Finland, held strictly among experts while lay people are generally only able to comment on the proposals. Ideally, the participants should be able to study and compare different alternatives made by experts, affect the formulation of the alternatives and even produce their own alternatives with the support of planners. Because this planning phase concretizes the notions of a 'good environment' into shaped plans that will then be negotiated and decided, inclusive participation is essential to support the element of democracy.

In some of the completed PPGIS projects residents have been allowed to evaluate different plan alternatives while the PPGIS allows for a more dynamic visualisation of the plan proposals and enables respondents to mark comments and opinions on a map. This phase could become even more efficient if the alternatives outlined could support transparency by highlighting how data collected previously have affected plan proposals. This aim is, nevertheless, not simple to implement as it is difficult to prove how such data has impacted the proposals.

Case Example – Improving a national park with local insight

Finnish forestry organization Metsähallitus allowed the park users to mark their favourite places (Figure 7). The majority thought that the park needed both wild and recreational areas. The results influenced the new maintenance and usage plan of the park, which separates the wild and recreational areas. In addition, a PPGIS feedback service was designed for alternative plans. The residents' ideas and opinions were thus included in the planning process on several stages.

"Maptionnaire is a significant new service to complement the traditional hearing meetings. It enables collecting opinions and wishes from wide stakeholder groups and presenting them in graphic form. The data material is received in GIS environment, which is a remarkable help. Therefore, it is ready to use in map presentations and information systems." — Senior Planning Officer Arja Halinen, Metsähallitus

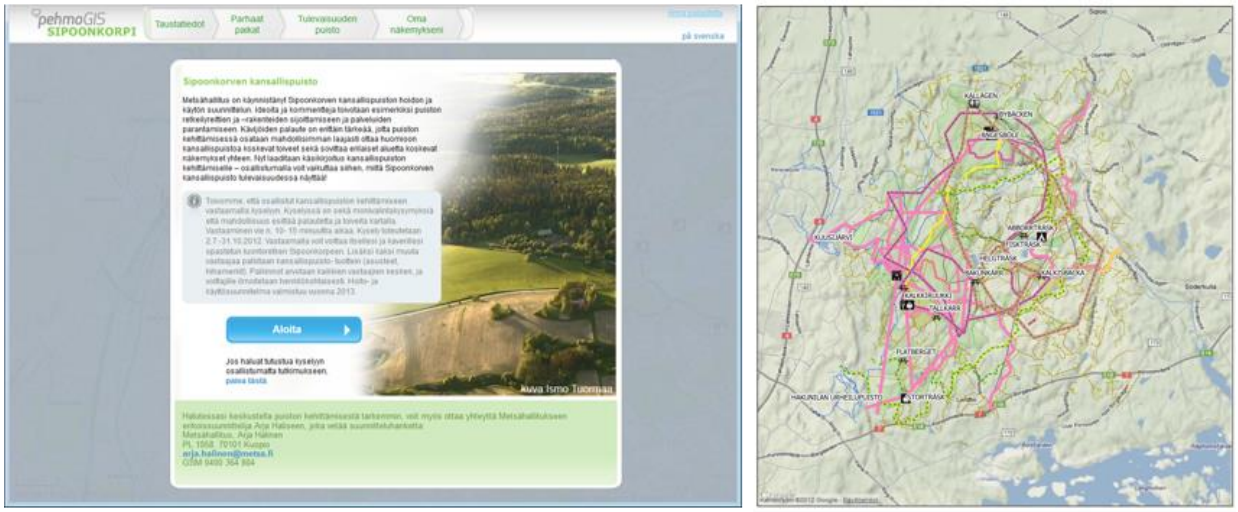

Figure 7 The survey used for marking the favourite places and routes of park users (left) and the map that summarizes the findings (right).

3.4. Decision making

The final decision making phase remains in the realm of the responsible institution where the decision is always preceded by a more or less informal process of negotiated policy formation. This highlights the importance of early stage participation in the planning process. Those networks that shape the discussion are often long-established policy networks with various interest groups. Whether existing policy networks are really representative of a broad enough range of residents' views remains questionable.

Our observation indicate that only in a few of the projects planners have been willing to use PPGIS tools during this phase. In Finland, during this step all officially expressed opinions should include personal data because planners are required to provide feedback to every opinion. This procedure often delays the process as planners can receive a significant number of opinions, each of which have to be carefully studied. Understandably, planners are not eager to push the use of the PPGIS tools during this phase as it would undoubtedly increase still further the number of complaints. Experts are afraid of information overflow where more information could lead to "further

confusion; obscuring, rather than clarifying the policy choices which could otherwise be made more easily under conditions of relative ignorance" (Young, Ashby, Boaz, & Grayson, 2002, 218).

3.5. Implementation

The implementation phase means the execution of the project through the construction of the buildings, installing the infrastructure, or the putting in place of some training or social programmes (Horelli, 2002). The adoption of a programme does not guarantee that the action on the ground will strictly follow policy makers' aims and objectives. Therefore participants should also be present during this phase, at least through information. Empirical evidence does not, however, currently support the use of PPGIS during this phase. Still, PPGIS would be applicable to support the information process or perhaps to collect feedback about the arrangements in the construction site.

3.6. Evaluation

The evaluation phase consists of the assessment of the monitored data gathered throughout the project and the evaluation of the changes in the physical and social structure. Horelli (2002) emphasises an ongoing evaluation throughout the entire planning cycle to better understand how participation has actually taken place during the process. Thus, evaluation is not restricted only to a particular stage in the policy cycle, but applied to the whole policy-making process from different perspectives and different timing (ex-ante, ex-post etc).

The research cases completed with the SoftGIS-tools support well the ex-post evaluation which should play a more embedded practice in the planning process. Evaluation could validate the effectiveness of public participation by testing the generated quality of the process and the quality of the received output and outcome. In reality, the actual effectiveness of public participation remains hard to pinpoint as most of the criteria discussed in literature are procedural rather than substantive in that they relate to what makes for an effective process, rather than how to measure effective outcomes (Rowe & Frewer, 2004). PPGIS tools offer a valuable way to accomplish ex-ante or ex-post evaluation (Kyttä, 2012). The research cases concerning for example the perceived quality of the living environment, environmental childfriendliness or perceived safety can be viewed as ex-post/ex-ante evaluation surveys. Here, the use of standardised queries would be helpful to better enable comparison between data sets in different places and cities.

Case example - Academic research on recreational water use
The researchers of Aalto University wanted to examine the recreational use and experimental value of the water areas of the Helsinki metropolitan area. A map survey asked the respondents to locate activity spots and landscape values near bodies of water. The survey reached over 2000 respondents. The results proved that the citizens enjoy spending time near water. The city shores are an important escape from everyday life.
"Mapping out the versatile nature of the best loved shores is a great opportunity — we can combine the big picture with detailed local knowledge, and qualitative information with location analysis, which leads to new interpretations." – Researcher, Jenni Kuoppa, Aalto University

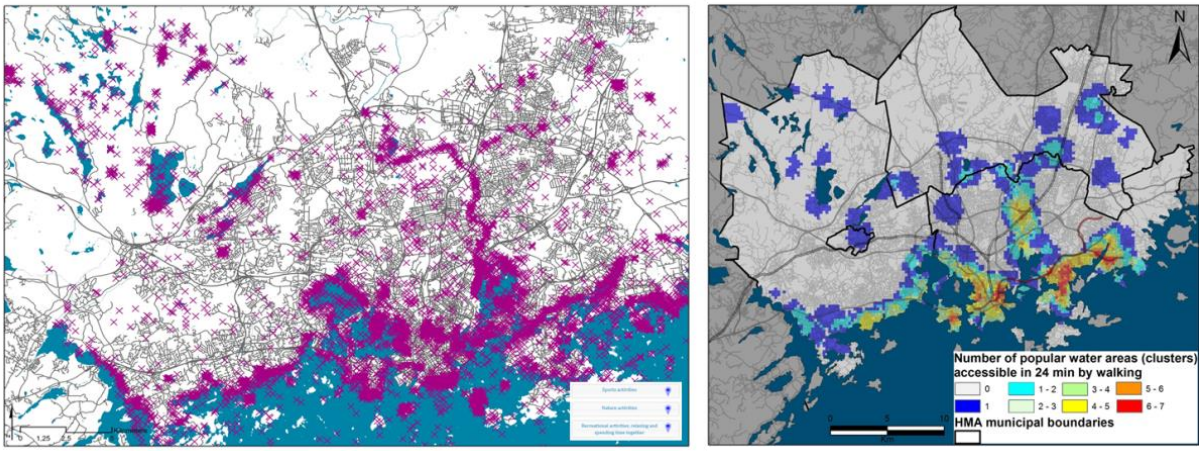

Figure 8 The activity spots by the water identified by the respondents (left) and a map to show how many important water areas are accessible by walking in different parts of Helsinki metropolitan area.

3.7. Maintenance

The maintenance phase means the transference of results and their nurturing into a long-term perspective (Horelli, 2002). The residents' role here can be more passive turning them into commentators on the current state of the environment. Regularly given feedback, such as e.g. Fix my street -service, could have an important role in raising awareness of the notifications made of the state of the living environment. Eventually this or the former phase can feed into the understanding that connects the process back to the problem definition stage completing the planning process loop. The maintenance phase differs from the evaluation phase in the way in which data is collected. In the evaluation phase it is important to use random samples to validate the data while in the maintenance phase data collection can occur on a more voluntary basis.

4. CONCLUSION

The aim of this paper was to introduce and go through the extensive set of PPGIS practices studied in Finland and abroad by the SoftGIS team in Aalto University. Long development work (2005-2015) of SoftGIS tools and a commercialized service Maptionnaire have provided us insight how research and urban planning practice can benefit of the use of these tools. PPGIS tools are potential methods when a person needs to ask the question "where". It is powerful to allow local people to produce their own maps expressing their personal experiences of their living environment. Whereas in research this kind of data opens new opportunities to study the person-environment fit in a novel way, in urban planning the benefits are twofold. On one hand, planners embrace this new information to support their knowledge-informed planning practices. On the other, they can take the advantage of the tools as new participatory mechanisms that consolidate the existing set of varying participatory tools.

The Maptionnaire software and its multiple applications have stimulated positive social change in the diverse fields of urban and regional planning, environmental psychology, and natural resource

management, among others. How? The software was the first to provide a user-friendly internet software platform allowing people to identify and map their activities, experiences, values, preferences, and other social attributes spatially, thus providing place-based data to inform important social decisions about current and future land use. The software also provides a platform for basic social research to better understand how diverse populations, including children, interpret and function in their physical environment. Historically, the "softGIS" software contributed to what has been termed the "geospatial revolution" over the last decade wherein the number of internet mapping software applications has increased exponentially.

The empirical findings suggest that various PPGIS tools are required to support different phases of the planning process and to offer new ways to grasp residents' views, experiences and opinions etc. Further knowledge is, however, required from planning processes where PPGIS tools are consistently used through different phases of the project. It would also be interesting to study the data transformation from raw data to planning proposals through the interpretation that shapes the collective understanding.

To anchor the PPGIS tools and location based user knowledge into the everyday routines of both the residents and experts, not so many new tools and innovative concepts are required. Rather, that challenge is to develop the existing planning culture to become more open to versatile knowledge and to embed new methods and ideas more profoundly into current practices. Our findings highlight the important role played by the 'super planners' who are willing to transform existing practices. As such, in order to overcome these institutional barriers in the future we cannot continue to rest alone on the shoulders of individual 'super' experts.

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